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THE EFFECT OF CHLOROFLUOROCARBONS ON THE ATMOSPHERE OZONE

Summary

The research program initiated in 1972 by chlorofluorocarbon manufacturers representing almost the entire world production exclusive of the U.S.S.R. and Eastern Europe is reviewed. Over \$3 million have been committed to date and a budget of over \$2 million has been approved for calendar year 1977.

Presently sponsored projects are discussed in the framework of the six NAS Panel recommendations for high priority research that could be accomplished in about two years. Comparisons are made with the earlier NAS Panel recommendations of July 1975 and those of the Interdepartmental Committee for Atmospheric Sciences of May 1975. Two documents are available that present the industry sponsored program in greater detail.^{1,2}

The results of recent work by Hill et al.³ on time series analysis of ozone data to detect abnormal trends are discussed briefly. It is suggested that this approach be examined thoroughly to determine its potential for (1) testing theoretical (model) predictions of ozone depletion and (2) providing a reliable "early warning system" for ozone depletion.⁴ If abnormal ozone trends can be determined by this technique with substantially greater sensitivity than was previously believed possible, practical limits can be placed on the scope of biological effects research and the urgency for regulation of chlorofluorocarbons as a precautionary measure will be diminished.

The results of Sze and Wu⁵ on model validation are discussed as an example of comprehensive analysis of experimental data employing alternative hypotheses. Data previously used to substantiate models in which an infinite tropospheric lifetime for FC-11 and FC-12 was assumed are shown to be equally consistent with lifetimes in the 10-30 year range. If the latter is true, the present most probable predictions of stratospheric ozone depletion by FC-11 and FC-12 will be reduced significantly. Care is urged in future comparisons of experimental measurements with model predictions.

The just announced⁶ finding at the National Bureau of Standards that sand and quartz promote photolysis of chlorofluoromethanes is noted. This observation is consistent with an early calculation by Rowland and Molina⁷ that indicated photolysis of C-Cl bonds might occur at wavelengths as long as 5000Å which can penetrate all the way to the earth's surface. The implications of these NBS results regarding adsorption and photolysis as a sink for FC-11 and FC-12 in the troposphere must be assessed quantitatively.

The chlorofluorocarbon industry welcomes comments and suggestions on its research program.

References and Notes

1. Summary, "Research Program on Effects of Fluorocarbons on the Atmosphere," Sponsored by the Fluorocarbon Industry, Revision No. 5, December 31, 1976.
2. Review of Industry-Sponsored Research, "The Effect of Chlorofluorocarbons on the Concentration of Atmospheric Ozone," December 31, 1976.
3. "Analyzing Worldwide Total Ozone for Trends," W. J. Hill et al., *Geophys. Res. Lett.* 4, 21-4 (1977).
4. The analysis indicates that the nine station network chosen for study allows detection of a 0.26% per year change over a six year period. This would detect a 1.56% total abnormal change and allow maximum depletion to be limited to 2.3%. It is estimated that an 18-station network would increase sensitivity to approximately a 1% abnormal change and this might be improved further by a larger network and satellite data.
5. "Measurements of Fluorocarbons 11 and 12 and Model Validation: An Assessment," N.D. Sze and M.F. Wu, *Atmos. Environ.* 10, 1117-25 (1976).
6. Chemical Week, March 2, 1977, p. 29.
7. "Chlorofluoromethanes in the Environment," F.S. Rowland and M. J. Molina, AEC Report No. 1974-1, Contract No. AT(043)-34, PA 126, September 5, 1974, pp. 17, 19.